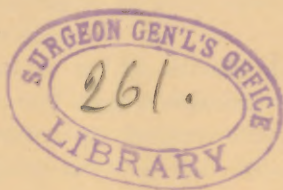


Bramble (D.D.)

# Hydrate of Chloral.

BY D. D. BRAMBLE, M. D., OF CINCINNATI, O.







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When we think of the worth of our predecessors, and that the greatest blessing for which they prayed, was

*"Men's Sana in Corpore Sano,"*

we blush at our own inferiority, though the telescope of science has revealed a perfect panoramic view of the citadel of medicine. The long and wearisome journey to the Jordan disappeared amid the more inviting and pleasant accessions to medical science.

Nature placed at our disposal in the *Papaverum Somniferum*, that noble principal, opium, that for countless ages relieved the suffering, soothed the smarting wound, and eased the stinging pain. Following in its wake came morphia, ether, chloroform, and chloral.

It would be vain for us to travel up the stream of time, and seek for a brighter history, and more flourishing age of medicine than that which crowns our profession to-day. The blue mist of fable and superstition has long since faded, and we now stand upon a tried foundation stone.

Anatomy, Physiology, Chemistry, Botany and Microscopy, has assumed for medicine the morning of a vast and glorious kingdom, whose temple of fame will cope with the hand of war, and accompany time through eternity.

At no time since the days of Æsculapius, has there been

as much interest displayed as marks medical pages to-day. Man seems cognate of his duty to man, and is establishing a therapeutical power, which no debt of gratitude can repay.

Our profession, shining with the transports of love, the fullness of life, the heaven-kissing ecstasies of hope, is rising in its temple of relief, vast, all beautiful and sublime, to its full meridian height, never more to culminate—and around it we should cling that it may be strengthened, so that by the touch of dissention it never can be shaken, but be permitted to rise and stand upon the topmost stone of the coliseum a twin sister of immortality.

CHLORAL.—(*Hydride of Trichloroethylene*.)

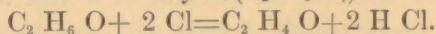
(Symbol.  $C_2 H Cl_3 O$ .)

This body was discovered by Liebig in 1832. It is the ultimate product of the action of chlorine upon Alcohol. ( $C_2 H_6 O$ .)

Alcohol may be decomposed by heat, electricity and chlorine. Chlorine gas is rapidly absorbed by alcohol, imparting to it a yellow color, and causing considerable rise in the temperature, which may cause the liquid to take fire, at the same time the chlorine abstracts hydrogen, which is replaced by chlorine, thereby producing hydrochloric acid, or aldehyde, acetic acid or acetate of ethyl, or chloride of ethyl, and finally chloral, owing to the amount of hydrogen displaced and chlorine supplanted.

The alcohol, by the action of the chlorine, is first converted into aldehyde, by the abstraction of 2 H, and the aldehyde is converted into chloral by the abstraction of 3 H, which is replaced by the chlorine.

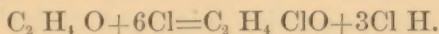
If we take absolute alcohol, ( $C_2 H_6 O$ ), and pass chlorine through it until 2 H is displaced and supplanted by 2 Cl, we would then have aldehyde ( $C_2 H_4 O$ ), thus:—



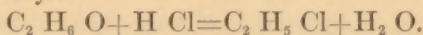
If we then take the aldehyde and pass chlorine through



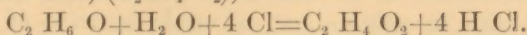
it until 3 H is displaced and 3 Cl supplanted, we will have chloral, thus :—



If only H were abstracted from the alcohol we would have chloride of ethyl.



If 4 H were abstracted and 4 Cl supplanted we would obtain acetic acid, ( $\text{C}_2 \text{H}_4 \text{O}_2$ ), thus :—



Hence we see that by abstracting 2 H, and supplanting 2 Cl, we obtain aldehyde and two parts of hydrochloric acid. And by abstracting from the aldehyde 3 H and supplanting 3 Cl, we obtain chloral plus three parts of hydrochloric acid.

Chloral cannot, however, be obtained direct from the action of chlorine on aldehyde. It may be produced in the first instant, but is soon converted into other products.

For the production of chloral from alcohol it is *absolutely necessary* that the alcohol be anhydrous, for if water is present some other product instead of chloral is produced. And even when chloral is made from absolute alcohol, there are other products accompanying it.

Chloral is also produced by the action of chlorine on starch and sugar. To make chloral from alcohol, use a long stem glass to contain the alcohol, and pass the chlorine through it. For making chloral the chlorine should be made from common salt, pulverized fine, peroxide of manganese and sulphuric acid (as this gives off chlorine more regular than hydrochloric acid and manganese.) The chlorine gas should first be passed through distilled water to wash it, and then passed over dry chloride of calcium to dry it, and then through the alcohol. Remembering that the alcohol must be kept cool to prevent its igniting.

At first the chlorine should pass through slowly, but after four or five hours it should pass through as rapidly as pos-

sible, or in other words, with great rapidity, for twenty or twenty-five hours, or until chlorine passes through pure. The alcohol assumes a yellow tinge, and gradually changes to a heavy syrup, which solidifies on standing for several days, and presents the appearance of a soft white crystalline mass, composed of hydrate of chloral, hydrochloric acid and undecomposed alcohol.

This crystalline mass is the *crude hydrate of chloral*.

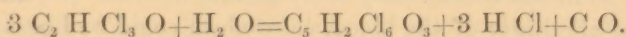
Then take in volume one of crude hydrate of chloral and four of sulphuric acid, and agitate together until the crude hydrate of chloral is dissolved, or cut up—set aside—when in a few hours a thin, hard white stratum will form on the top. If this stratum should not form, the chlorine must be passed through the alcohol longer. If this hard stratum forms, lift it off, and to one part of this add five or six of pure sulphuric acid: apply heat and melt the crystalline mass, let it stand and rise again, then draw off with a *pipette*. Then distill over lime and remove the hydrochloric acid, and in this manner you obtain chloral pure, but not until you have repeated this process several times.

Stadler obtained chloral from sugar and starch by distilling with hydrochloric acid and per oxide of manganese.

Pure chloral is not known only as a chemical curiosity, it being so difficult to prepare it without having water in it—hence we use the hydrate of chloral and call it chloral. Chloral is greasy to the touch, and will make grease spots on paper that will soon disappear. It has a peculiar, pungent odor, and excites a copious flow of tears; its taste is greasy and slightly astringent. It acts very strongly upon the skin, and might be classed among the escharotics. It has no acid reaction, even when dissolved in water, and will not precipitate a solution of silver. Chloral is readily dissolved in alcohol and ether, and it will readily dissolve iodine, bromine, sulphur, and phosphorous, by the appliance of heat. The iodine solution presents a purple color.

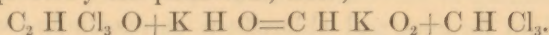
Chloral, with a small amount of water added, solidifies and forms a mixed mass of hydrate of chloral. ( $C_2 H Cl_3 O + H_2 O$ .) The boiling point of hydrate of chloral is  $230^{\circ}$  Fah.; it solidifies at  $104^{\circ}$  Fah., but an excess of water will vary the solidification.

Pure chloral generally distills unchanged with pure sulphuric acid, but if hydrate of chloral be heated with sulphuric acid part of the chloral distills over into the anhydrous state, and the rest is converted into chloralide, ( $C_5 H_2 Cl_6 O_3$ ) thus:—

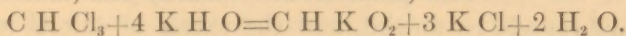


Chloralide is insoluble. Nitric acid converts chloral into terechloracetic acid. ( $C_2 H Cl_3 O_2$ .)

Anhydrous metallic oxides, such as baryta, strontia, lime, cupric oxide, mercuric oxide, and peroxide of manganese, have no general or specific action on chloral. But alkalies, either solid or aqueous, readily decompose chloral at ordinary temperatures, converting it into a formate and leaving a portion of chloroform, and the chloroform is also partly decomposed by the potassium, thus;—



The chloroform that has thus been liberated is now seized upon by the overplus of potassium and chloride of potassium is formed, and carbonic acid liberated, thus:—



Ammonia forms with chloral a peculiar compound that will reduce silver.

Dr. Dumas investigated its chemical properties the second year after its discovery. Kopp, Wurtz and Regnault, also investigated its chemical properties, and it was placed among the alcoholic products in common with aldehyde and chloroform. Then for nearly thirty years this valuable chemical lay in darkness until Dr. Oscar Liebreich, who in searching for some way to liberate chloroform in the blood and produce a similar effect as by inhalations, commenced experiments



with this alcoholic product. It was ascertained that strong acids did not affect it. But if an alkali be added to a solution of hydrate of chloral, it would split up into formic acid ( $C H_2 O_2$ ) and chloroform. The formic acid uniting with the alkali and forming a formate.

If to a solution of hydrate of chloral caustic soda be added, the formate of soda is left and chloroform is liberated. This then led Liebreich to believe that if in the crucible, by adding hydrate of chloral to an alkali, chloroform could be liberated, so in the human body if by adding hydrate of chloral to the alkalinity of the blood, chloroform could be liberated in the system and produce all the phenomena of inhalation of chloroform.

If then any alkali be acted upon by hydrate of chloral as potassa, soda, or ammonia, it is changed into a formate, and chloroform is given off, and a portion of the liberated chloroform unites with the potassa or soda, and forms a chloride of the alkali.

But if any amount of an alkali be added, only an amount corresponding to the contributing equivalent will be converted into formate, and chloroform corresponding will be given off, while the excess of the alkali will remain, and vice versa, if more chloral be added than the combining equivalent of the alkali, the proportionate quantity of formate and chloroform will be formed, and the excess of chloral will remain unchanged.

The fact of the evolution of chloroform from the uniting of an alkali with chlorine should be understood lest we combine an alkali with chloral in our prescriptions, and liberate chloroform long before the patient receives the prescription, and then instead of chloral he will swallow the formate of the alkali, and the sad tale of sorrow to the Doctor next day is, "your medicine did me no good; I didn't sleep any all night long."

The chemical affinities of this new agent needs to be



thoroughly understood by physicians and druggists. Hundreds of our physicians have prescribed it, and reported upon it.

Its physiological and therapeutical action has been tested and investigated by many of our leading physiologists, such as Demarquay of France, Drs. B. W. Richardson and J. R. Russell of England, Dr. Wm. Hammond of New York, Da Costa of Philadelphia, and a retinue of others. It has been used in experimenting upon nearly all classes of animals. It has been used in hospital and private practice with good and with evil results. And like any chemical that is clothed in mystery, from its intricate formation and so susceptible of change: being used by highly educated medical men and by ignorant pretenders. By graduates and non-graduates. By regular physicians and quacks.

Combining it with alkalies, acids, and saccharines—compounded by incompetent drug clerks, and given at random, so that to-day it has its laudations and detestations, and from the fact that its principal element is chlorine is evidence that it is highly susceptible of change—its affinity for other substances being so great.

Chlorine itself being a virulent poison, and the great number of compounds that can be formed from oxygen and chlorine, from water and chlorine, was a mountain for physiologists to overcome, and in placing chloral among the highest of our therapeutical agents, we will always have to contend against its tendency to chemical change. That it is, when pure and handled with care, a great somnolent anodyne, possessed of great therapeutical powers, we will not call in question. But that its destiny is to be to medicine what chloroform has been to surgery, we are not willing to admit. We have in this a great chemical agent, intimately in alliance with physiology, and in proportion to its greatness as a chemical agent so is its liability and minute susceptibility to chemical changes and its physiological actions will accord to

its chemical actions and be subject to as much change physiologically as chemically, and never can occupy that grand position to which Liebreich and Dumas ascribed to it.

Until lately chloral has always been investigated only in an abstract theoretical point of view, and never was known as a therapeutical agent much less one of the most efficient and precious.

Opening then before us in this day of modern light, and medical lore, with the veil of mystery still hanging before our eyes, is a field of inquiry and research, of which but little is as yet known, of the exact agencies and proficiencies of this novel drug.

Freeing ourselves from the restraint of all schools and "pathys," and relying upon the chemical affinity as revealed in the test tube and crucible, as well as in the human body, we are called to investigate and place upon our therapeutical list a novelty that no doubt is destined to be as the waters of a second Jordan, and cure all the ills to which human flesh is heir, and dare to almost stand face to face and grapple in a hand to hand contest with death.

Heretofore chloral, as has been said, was considered in an abstract theoretical manner. But now it should be considered in its general physiological actions.

1st. All theoretical changes alluded to are not to be found, unless by the most minute and thorough chemist, and physiologically we will have but few changes, so that we can with some assurance of success predict a glorious future for chloral.

2d. Chlorine with its great property of unstability in its separate state, has in chloral the form of great stability, owing to the components with which it is united in forming chloral, and thereby has less adaptability to physiological change in this form than any other.

Then when introduced into the organism we need not be alarmed lest it should assume divers numbers of compounds,

as it does in the chemists' hands, for these changes are mostly the finely worked-up discoveries of the chemist, formed only when certain minute proportions are made to exactly correspond.

Experiments upon animals and man have been instituted, and from these we may derive some of the more accurate actions of chloral on the organism, and perhaps learn how to administer it with more advantage to the patient and less injury to our reputation.

M. DEMARQUAY.

(Communicated to the Academie des Sciences.) His experiments upon rabbits :

"I have experimented on a great number of rabbits, injecting into the cellular tissue of these animals from 20 centigrammes to 1.20 gramme, without causing death in any of them ; all in from fifteen to twenty minutes fell into a deep sleep. The duration of this sleep was between two and three hours, and however great had been the muscular resolution and the depression of these animals, they all recovered. On the following day they were in a marvellously good condition. I have been enabled to make use of the same rabbits in several experiments.

The following appearances may be made out by attentively watching them. The ocular and palpebral mucous membranes are injected. The ears are vascularized in a manner quite remarkable, one would think these animals had undergone section of the great sympathetic, according to the fine experiments of M. Claude Bernard.

There is no increase of temperature in the vascularized parts, sensibility seems to be quickened and their faculties exalted. The slightest pinch of the tail or ear, excites unruly movements and whining cries, such as are not heard when a healthy animal is irritated in the same manner. The pulse, under the influence of chloral, becomes extremely fre-



quent, and the animal temperature of the body is lowered. Frequently when narcotized by chloral they exhale by their nostrils the odor of this substance, which would lead one to suppose that it is not decomposed completely in the blood, if it be at all decomposed in the blood. (It seems that Demarquay doubts its decomposition in the blood.)

If one opens during life the bodies of animals narcotized by chloral they will find the abdominal viscera congested, the vessels of the mesentery turgescient, the mucous membrane irritated, particularly that of the trachea. The central nervous system, the brain and cerebellum and their membranes, are strongly injected, as well as the cord and its membranes. But on account of the small size of the sympathetic I have not been enabled to recognize any change in color.

FISHES.—Fish are readily narcotized by hydrate of chloral. By mixing chloral with the water in which they are swimming they inhale it slowly, and at last fall asleep. A large carp was put to sleep by Dr. Sedgwick with a subcutaneous injection of 5 grains of the hydrate of chloral. The breathing is regular and gentle, altogether oblivious and insensible.

To insure their recovery they must be placed in good fresh water, so that the eliminated products may be quickly carried away.

MICE.—Mice are easily and readily narcotized by chloral. A half grain being sufficient to put a mouse weighing an ounce to sleep, and when asleep resembles a dormouse in a state of hibernation. They pass into sleep without any excitement, and recover without any baneful symptoms.

FROGS.—The poor frog has to suffer, and though he would gladly go "chug" into his watery home, yet insatiate man gathers him up, and subjects him to every torture and appliance that human ingenuity can invent, and then has him nicely prepared for his own stomach's sake.

Frogs are quickly and easily narcotized by chloral, a half grain being sufficient to seal his majesty in sound sleep, and three-fourths of a grain generally causes the largest and oldest frog to "sleep the sleep that knows no waking." As soon as the chloral begins to take effect, his head drops, his limbs are relaxed, his eyes close, and he quietly sinks into a profound stupor. His motions are cataleptic, his limbs remaining in whatever state they are left. The sleep in a frog will last for a period of 20 hours.

Take two frogs, give one a large dose and the other a small one, the one with a large dose will lay, with imperceptible breathing and seemingly dead, *and may possibly be dead*, while the one that was treated to a smaller will lay calm and breathe softly, and in about twenty-four hours, at a moderate temperature will wake up. They have no sensibility when under the full influence of chloral. Every function of life but the circulation seems stopped. And when sleeping so soundly as to pass for dead, place the web of the foot under the microscope, and there is seen the circulation going on in the most perfect manner."

There seems to be no sensibility. Then we would have:

1st. Deep sleep, quickly produced and if carried far enough, fatal anaesthesia.

2d. Chloral acting without any excitement.

3d. We find waking up without any bad effects—or more like awakening from a natural sleep.

4th. In fatal doses the nerve power of the heart is the last that suffers, and upon examination we find the auricles and ventricles filled with blood—as if life had been stopped by paralysis of the heart, paralysis seeming to take place first in the ganglionic cells of the brain, next in the ganglionic cells of the spinal cord, and lastly in the ganglionic cells of the heart.

This then leads us to seek for the action of chloral. We have seen that when the hydrate of chloral is treated with an alkali

it is resolved into a formate and chloroform is liberated. The blood is an alkaline fluid. If then the hydrate of chloral be introduced into the organism, every small particle of it will unite with and consume a corresponding quantity of alkali, and the decomposition of chloral will be effected only as the blood furnishes an alkali.

Chloroform being liberated in the blood, requires only the smallest space of time to be conveyed to the ganglionic cells of the cerebrum, when the minutest quantity of chloroform would then take on its first action in the ganglionic cells of the cerebrum,\* and as the chloroform increases, the action increases and extends to the ganglia of the spinal cord, and lastly it extends to the ganglionic cells of the heart. The first action corresponds with the slowest possible elimination of chloroform, and the removal of chloroform from the body is *not* by its being converted into carbonic acid and hydrochloric acid, but passes off as pure chloroform.

Dr. Richardson says he detected the odor of chloroform in the breath of animals sleeping under the influence of chloral. This corresponds to the researches of Dr. Snow, upon chloroform, who showed clearly that its extrication was unaltered. Chloroform; which is the active agent produced by giving chloral, is most beautifully described by Dr. Simpson to the Medico-Chirurgical Society of Edinburg, on Nov. 10th, 1847.

As to why we use chloral in preference to opium, might be answered in the words of Dr. Snow: "For the same reason that you use phosphorous matches, instead of tinder box, an occasional risk never stands in the way of applicability." He no doubt thought of the Portland fire that was caused by matches, and yet every man, woman and child, still uses matches.

The organ most frequently smitten by chloroform or by giving chloral, is the heart. The lungs are affected by the

\*Dr. Richardson, *Medical Times and Gazette*, Oct. 30th and Nov. 6th, 1869.



chloroform that is formed coming in contact with the pulmonary branches of the pneumogastric nerve, and they suffer from paralysis of these branches. Chloroform first affects the ganglia of the cerebrum, then the ganglia of the cord, and lastly the ganglia of the heart. The heart is affected last no doubt on account of its great self-sustaining power. The heart, fed by the coronary arteries, receives the first blood thrown from it at every stroke, and since, as was shown, the slightest quantity of chloroform first affects the ganglia of the cerebrum, and the next larger quantity the ganglia of the cord—the last and greatest quantity would exert its influence upon the heart.

If then the blood by which the heart fed not only the whole body, but itself, is normal, then normal blood would supply the heart, but if the blood should contain chloroform, and thereby be abnormal, the heart would be the organ that would receive the first injury, and when this abnormality was sufficient to produce death, we would then have the nerve power of the heart smitten lastly by this agent. **Birds were next taken.**

Pigeons are readily narcotized with a small amount of chloral, from one and a half to two grains.

From the experiments of Dr. Richardson no excitement preceded the sleep, but the birds, as after chloroform, usually showed signs of nausea as they became drowsy. The character and degree of sleep varying with the dose; one grain and a half producing drowsiness in ten or twelve minutes; deep sleep in an hour, and two or three hours of interrupted sleep—2 grains produced deep sleep in ten minutes, with perfect insensibility for 26 minutes, and interrupted sleep for some hours. Two and a half grains produced complete anaesthesia in 20 minutes that lasted one to two hours.

With these sized doses they generally wake with slight reflex movements or with  $2\frac{1}{2}$  grain doses with tremors. Five

grains produced complete insensibility in 16 minutes, with convulsive movements and death in 50 to 60 minutes. Seven and a half grains produced insensibility in 5 minutes, and death in 47 minutes, preceded by convulsive movements.

In all these cases the odor of chloroform was distinctly perceptible in a few minutes after administration. In every bird there was a decrease of animal temperature, and the temperature varied according to the amount given.

Recapitulation of the experiments on pigeons.

1st Pigeon	1½ grains,	deep sleep in one hour,	no insensibility.
2d " 2	" " " " " 10 minutes,	insensibility for 26 minutes.	
3d Pigeon	2½ grains,	complete anaesthesia in 20 minutes,	insensibility for 1 to 2 hours.
4th Pigeon	5 grains,	complete insensibility in 16 minutes,	death in 50 to 60 minutes.
5th Pigeon	7 grains,	complete insensibility in 5 minutes,	death in 47 minutes.
	1½ grains reduced	temperature	2° Fah.
2	" "	" "	5° "
5	" "	" "	8° "
7	" "	" "	10° "

Dr. Oscar Liebreich, in his communications to the Berlin Medical Society, gave its chemical history and chemical changes, and then the change in the organism together with its effects on animals.

A small dose, 1-10 grammes, produced narcosis in a very young kitten. The animal sleeping quietly, did not manifest any of the excitant stage of chloroform anaesthesia. He produced hypnosis of nine hours duration in moderate kittens by injecting ½ grammes of hydrate of chloral.

His experiments upon frogs seemed to show more regularly and more clearly the effects of chloral. (When the ganglia of the cerebrum were effected.) The animal allowed himself to be placed in any position and so remain, (possessing reflex excitability.) Then came on a stage, (when the ganglia of the cord were effected,) when the reflex excita-

bility was lost, and if a fatal dose had not been employed the frog would return to his natural condition. But if a fatal dose was administered the heart would be found gorged with blood as though dying from heart paralysis.

In his communication he recommends the hydrate of chloral for neuralgia and rheumatism, for convulsive cough and tetanus, for acute mania, delirium tremens, gall stone, and for removing the pains of surgical operations. We will now quote from the researches of Dr. B. W. Richardson, of London.

Dr. Richardson tested the virtues of hydrate of chloral on fishes, frogs, mice, birds, and rabbits, and then administered it to man and recorded the same symptoms (so far as they had been traced) as in the lower animals. Long sleep, lasting for several hours, has resulted in men and women from one dose, varying from 20 to 60 grains, and men in the frenzy of acute mania have been brought into quiet sleep by one or two drachms. The sleep is gentle, with no symptoms of distress, and leaves no serious evil behind.

In every animal, from the lowest to the highest, the sleep is induced, not merely without pain, but seemingly with great pleasure, assuming their natural manner, the rabbit arranging himself, and the cat purring as they pass into calm and oblivious repose.

Weight seems to influence the effect—an animal weighing 3 ounces requiring 1 grain to be brought fairly under its influence, and the influence varies as the dose is less than 1 grain. In the human subject we must take into consideration not only the size and weight, but obesity, leanness, natural habit, and actual state of body in respect to sensibility. Though Dr. Richardson contends that "the quantity of the dose should vary with the weight of the body," we feel like assuming altogether a different theory for the gradation of the dose, to-wit, the dose of the hydrate of chloral should correspond to the alkalinity of the blood, since it is by the



evolution of chloroform from the contact of the chloral with the alkali of the blood.

The less alkali the less chloroform would be generated and the more alkali the more chloroform would be generated, hence the greater the effect, but with a small amount of alkali the more chloral should be given, so that a greater amount of carbonic acid would be generated in the second action, and the result desired would be approximated to. But with a great amount of alkalinity it is very easy to see that less chloral is required, or too great a quantity of chloroform would be generated.

Dr. Richardson then gives the following summary:

1st. Deep and prolonged narcotism can be safely produced by the hydrate of chloral.

2d. During a portion of the period of narcotism there may be complete anaesthesia, with absence of reflex action, and a condition in which every kind of operation fails to call forth consciousness.

3d. During the narcotism there are intervals of apparent exalted sensibility.

4th. In the transition from drowsiness to stupor, there is no stage of muscular excitement, but in birds there is vomiting, as is common in the same animal in the second stage of narcotism under chloroform.

5th. During narcotism produced by this substance, there is invariably reduction of temperature.

6th. The hydrate produces muscular relaxation, which relaxation extends to the muscles of volition and alike to the iris and muscular arterial system. From the condition of the muscles after death, we may infer that this paralysis is in part due to change within the muscular structure itself.

7th. The action of this substance on the nervous system is primarily on the sympathetic ganglia, afterwards on the cerebrum, and finally on the heart.

8th. Recovery when it takes place is followed by no bad results.

9th. In fatal cases the functions destroyed are—1st, The cerebral ; 2d, The voluntary muscular ; 3d, The respiratory ; 4th, The heart.

10th. This substance, in small proportions, arrests in some degree the coagulation of the blood, and in large quantities stops the coagulation altogether. In large quantities it also destroys the blood corpuscles, and produces general destruction of the blood ; but the dose required to produce extreme narcotism need not be so large as to lead to serious derangement of the blood.

11th. The phenomena observed correspond with those observed under chloroform, and the balance of evidence is that they are the result of the action of chloroform.

12th. Summing up the facts, the hydrate of chloral *produces sleep, removes sensibility, reduces the animal temperature, and causes extreme muscular relaxation.*

Taking these facts as our guide we may reasonably put it to the test for the relief of various diseased states and conditions.

Views of the editor of the London Lancet, Oct. 2d, 1869 :

“The idea that the hydrate of chloral is intended to supersede chloroform, bichlorite of methylene, ether, or the other volatile anaesthetics, as an agent for removing pain during the performance of surgical operations, is AN ERROR. Whatever may have been the hopes of the distinguished Leibreich himself on this point, when he originally thought of employing the agent, *they have not been realized.* Nor has it been put forward as the rival of the agents named for surgical anaesthesia. IT IS AS THE RIVAL OF OPIUM that hydrate of chloral demands our consideration. Speaking simply of its effects on the body, and leaving out of view the theory of its action, and its supposed decomposition within the organism, we may state definitely that the hydrate

when administered in an efficient dose, (a drachm is not an immoderate dose for an adult,) produces on man and inferior animals a kind of stupor or sleep, which may be made to extend over five, and even over seven hours, with comparative safety.

The stupor is sometimes preceded by nausea, and in birds it is always preceded by vomiting. It is attended with great muscular prostration, and with a decrease of animal temperature. During the period of stupor there is an interval of perfect insensibility to pain; but the interval is short, and for the greater part of the period the sensibility is either natural or *exalted*. This fact of the exaltation of sensibility which was especially dwelt upon by the reporter at Exeter, has been confirmed by the researches of Demarquay, of Paris, whose paper was noticed in the *Lancet*. It is a fact as curious as it is important; and indeed the whole subject is one of interest."

But, as we have already intimated, the first question to be made out in practice is, whether hydrate of chloral can be used for sustaining sleep in the same class of cases as those in which we now administer *opium*. We see that the editor speaks of two important actions: the first, is chloral the rival of opium or is it not. Second, does it exalt the sensibilities or not.

Views of Edward H. Clark, M. D., Prof. of Mat. Medica in Harvard University:

After giving the history of its discovery and chemical affinities, he says, "A knowledge of the physiological action of the hydrate of chloral on man is an indispensable guide to its use in disease. We do not yet comprehend this action completely, but we know enough of it to aid us materially in its chemical administration. The points of greatest importance to the practitioner are its absorption, its elimination, the changes which it undergoes in its progress through the sys-



tem, and its action on the system from the period of absorption to that of complete elimination.

Hydrate of chloral is readily absorbed by the mucous surfaces of the stomach and rectum, and also by cellular tissue. It is easily and quickly absorbed by the stomach if largely diluted, and moderate doses may be absorbed in a few minutes. Fifteen grains were administered to a patient, who fell asleep in ten minutes, from which it is fair to infer that the whole or nearly the whole of the quantity given passed from the stomach into the blood within that space of time. The stomach appears to be capable of passing into the blood any quantity of hydrate of chloral that may be put into it, provided it is pure and sufficiently diluted. Hence any quantity of it may be given at a dose, so far as the stomach is concerned, that it is wise to administer.

#### PROGRESS THROUGH THE SYSTEM.

Hydrate of chloral goes from the stomach into the blood unchanged. In the blood it meets with an alkali, and experiments show that chloroform is evolved in the system the same as out of the system. The amount of chloroform thus given to the blood is proportionate to the quantity of chloral absorbed, and also proportionate to the alkalinity of the blood.

The total quantity of chloral is not immediately decomposed into chloroform. The chloral mixes with the blood, and passes with it to every part of the organism, and as it circulates, continues to yield chloroform until it is exhausted. In cases of fever of a low type, such as typhus and typhoid fever, when the blood is highly charged with ammonia, it is then in a state to extract chloroform from chloral more rapidly than when it is less alkaline.

Under such circumstances a given dose of hydrate of chloral should produce its physiological action more rapidly and powerfully than in ordinary doses.

**ELIMINATION.**—Most, if not all, of the hydrate of chloral is eliminated from the system in the form of chloroform, into which it has been changed.

**ITS ACTION ON THE SYSTEM.**—Hydrate of chloral, while in the system, affects especially the blood, the cerebro-spinal axis, the heart and arteries, the muscular system and temperature.

**THERAPEUTICAL INDICATIONS.**—The therapeutic indications and contra indications which these physiological phenomena point to are obvious. Hydrate of chloral may be given so as to produce sleep, diminish sensibility, allay irritation, slow the heart, relax muscular tissue, lower animal temperature, devitalize the blood, cause anaesthesia, and destroy life. Part of these phenomena have a therapeutic value, and part are toxic. They may be arranged in two groups.

**THERAPEUTIC GROUP.**—Sleep ; diminished sensibility ; diminished irritation ; muscular relaxation ; contraction of arteries.

**TOXIC GROUP.**—Slow or irregular pulse ; complete anaesthesia ; altered blood globules ; great diminution of temperature ; great muscular relaxation ; death.

In the administration of chloral, it is its therapeutic phenomena and not its toxic that we wish to obtain. This can be accomplished by proper attention to the purity of the article and mode of administration.

As chloral has been used in a variety of diseases, and in various doses, with various effects, and even with no effect, we will submit a number of cases before we draw our conclusions.

#### CASES OF NEURALGIA.

**CASE 1.** By Dr. T. Spencer Wells, *Medical Times and Gazette*, Sept 18, 1869. Sciatica, two grains of morphia given subcutaneously were necessary to procure sleep. Thirty grains chloral given procured best night's rest she had enjoyed.

Same dose repeated following night with like result. Subsequently increased dose to 40 grains to insure perfect rest, which was always obtained except on one occasion, when, on account of a severe relapse,  $\frac{1}{2}$  grain of morphia and 1-60 grain atropia was injected two hours before administration of chloral. Drug continued for three weeks.

CASE 2. Lady: Occipital Neuralgia; thirty grains of chloral produced no hypnotic effect; the patient suffered so much from burning pain in the throat and stomach that she declined further experiment.

CASE 3.—By J. C. Ogilvie Wills, M. D. Facial neuralgia, treated by sub-cutaneous injection of  $\frac{1}{8}$  of grain of morphia at seat of pain, with instantaneous relief; this was repeated for four days, when he was complaining much of want of sleep, when 30 grains of chloral was administered. In less than seven minutes he fell into a calm slumber, which lasted for eight hours. The chloral was repeated each night until the patient was convalescent.

CASE 4.—By J. C. O. Wills, M. D. Most distressing case of neuralgia, where hypodermic injections of morphia and atropine, bromide of potassium in small doses, and opium in large doses failed to induce sleep; thirty grains of chloral was given; this also failed. Fifteen minutes after 30 grains more were given. Five minutes later the patient was sound asleep, and did not wake for seven hours. On the following night 5j was given; sleep followed immediately, but not of as long duration.

For the ten following nights, 5ij were given. Sleep invariably came on within five or six minutes, duration varying from eight to twelve hours, and the patient awoke on every occasion without experiencing any of the unpleasant after effects some have ascribed to this drug.

CASE 5.—By J. M. Palmer, M. D., Dalton, Ohio. Lady: victim of paroxysmal neuralgia of head as well as severe attacks of sciatica. Best known remedies gave only temporary

relief, often had to resort to chloroform during attacks of hemicrania.

During one of her accustomed attacks gave 10 grains of chloral; in an hour after free from pain, and quietly sleeping. At 1 A. M., three hours after, felt some pain; gave 10 grains, after which she slept till morning. At 10 A. M. found her suffering intensely, gave 10 grains; waited an hour, no relief; then repeated same dose, still no relief; then gave 16 grains; in an hour patient was relieved, and slept until night. At 8 P. M. pain returned; gave 20 grains, which had the desired effect; patient slept till next morning; has had no return.

CASE 6.—By G. R. Patton, M. D., of Cincinnati, Ohio. Neuralgia of head twelve years standing; attacks periodical, lasting four or five days; medication had little influence in limiting duration of disease. In one of her attacks, at its greatest intensity, administered 30 grains of chloral per rectum, from this she slept some. In two hours 30 grains more were given in same manner, and in half an hour she fell into a tranquil and uninterrupted sleep of six hours. When she awoke had no pain.

CASE 7.—By Dr. H. A. Spencer, of Erie, Pa. States in Medical and Surgical Reporter, page 401, May 14th, 1870, that he used chloral in one case of neuralgia, without any good effect. He gave 30 grains in divided doses, his patient only slept half an hour; he repeated the medicine, the patient getting no rest or sleep until morphia was administered.

CASE 8.—By C. E. H. Rogers, London Lancet, May 28th, 1870. Relates a case of neuralgia in the supraorbital and intercostal regions, relieved by chloral, but was followed by intense headache, that only ceased on the suspension of chloral.

#### CASES OF TETANUS.

CASE 1.—Prof. Verneuil submitted to the Academy of Sciences, of Paris, the case of a young man who suffered



from tetanus in consequence of a crush of extremity of right radius. The patient took chloral for a week, the dose varying from 90 to 180 grains per diem.

CASE 2.—Mr. Spencer Watson, *London Lancet*, July 16th, 1870. Woman 41 years: traumatic tetanus. Chloral was given in intervals of four, six, and eight hours, in doses varying from 30 to 60 grains, for fourteen days; on one or two occasions coma seemed to be impending, the dose was omitted, but restlessness and lividity of the face having come on, with slight opisthotonos. During these intermissions the full dose was resumed, and these symptoms subsided. Bowels acted only after repeated doses of croton oil. Pulse varied from 70 to 120, temperature from  $99\frac{20}{5}$  to  $100\frac{20}{5}$ . The jaws can now be opened and swallowing is quite easy for soft solids.

CASE 3.—Under the care of Mr. Moxhay, Royal Berkshire Hospital, *L. L.*, Aug. 27th, 1870, page 293. Traumatic tetanus in man, aet. 25, occurring 10 days after injury; treated for four days with calabar bean, but without effect; then gave thirty grains of chloral, which produced five hours sleep. On waking spasms were less violent, and seemed altogether better. Dose repeated again, producing sleep; chloral continued for three days; 30 to 40 grains night and morning, always with relief to spasms, and followed by sleep. He then died from hæmorrhage from sloughing of vein.

CASE 4.—Under care of Mr. May. Traumatic tetanus. Boy: aged 13; treated first with calabar bean, 3 grains every 3 hours; difficulty increasing; spasms so violent as to require artificial respiration. Then gave with difficulty 30 grains of chloral which put him to sleep, slight spasms occurring during the night; after this 20 grains were administered per rectum once or twice daily, and always with the effect of relieving spasms and giving rest. On the 39th day had

scarcely any spasms; the enema of chloral continued. One month later he was discharged well.

CASE 5.—Under care of Mr. Birkett, Guys' Hospital, L. L., Sept. 24, 1870, page 534. Traumatic tetanus. Man: aged 26. Gave 30 grains of chloral every 4 hours for two days; continued to get worse; gave then in the place of chloral 1 grain of opium every three hours, which was continued for four days, patient getting worse. Then resumed chloral; gave first dose 5i, followed by 15 grains every two hours; following day a little better; slept several hours. This was continued for six days; then increased the dose, giving 25 grains every two hours for three days. Then diminished to 15 grains every two hours; from this time medicine was given less frequent, and in three weeks chloral was left off.

CASE 6.—Great Northern Hospital, under care of Mr. Spencer Watson, L. L., Sept. 24th, 1870, page 434. Traumatic tetanus. Female: aged 41. This patient was kept more or less under the influence of chloral by giving 40 grains every four hours during the day, and 60 every six hours at night, often sleeping continuously for eight or ten hours, and even during the day remaining so profoundly unconscious that she was only aroused with difficulty. The chloral was then discontinued with a view of ascertaining how far the relaxation of the jaws already obtained would become permanent. On the following day patient became so violent both in her language and demeanor that it was necessary to put her in a straight jacket. Chloral was again given in 40 grain doses, with the effect of calming the excitement; this was then continued for nine days, then discontinued, the jaws remaining relaxed. Recovery was now steadily progressive.

CASE 7.—Dreadnought Seamen's Hospital, L. L., page 435, Sept. 24th, 1870. Idiopathic tetanus. Male: aged 37. Five days standing; four j5 dose of chloral were given at

intervals of three hours. Four hours after last dose very decided and severe spasms, affecting the hands and feet, came on, eliciting loud cries. Pupils were then contracted; chloral discontinued for a time, and brought partly under influence of chloroform whenever there was a return of the spasms. During the afternoon of same day chloral was repeated and chloroform frequently given. The patient passed very little urine, had no stool, but took fluid food at intervals of about fifteen minutes, and had a very fair amount of quiet and genuine sleep. In the evening chloroform was again administered on account of an unusually severe spasm, with screams, but died very suddenly, 20 minutes after, in a severe convulsive fit.

The progress of this case was more hopeful than usual. The experience gleaned in this instance tends to indicate that chloral is worthy of an extended trial, with inhalation of chloroform, whenever the tetanic spasms threaten.

CASE 8.—Dr. Gronemaunhas, published in L. L., page 713 Nov. 19th, 1870, the case of a man aged 44: traumatic tetanus. Chloral alone did not relieve the spasms, but when *morphia* was given with it, the improvement was manifest. The prescription was as follows: Hydrate of chloral, 150 grains; hydrochlorate of morphia, 3 grains; aq. dest. and syr. simple, *a a* 5j. One fourth of this given night and morning. The man recovered.

CASE 9—Royal Surrey County Hospital, under Mr. Eager, L. L., page 742, Nov. 26th, 1870. Male, age 23: traumatic tetanus. Gave *oj*, which was then followed by 30 grains every three hours. Chloral continued for three days with apparent benefit; succeeding three days chloral was given in same way, but patient continued to grow worse, and died at end of the sixth day.

CASE OF ACUTE TETANUS, TREATED BY HYDRATE OF CHLORAL AND PHYSOSTIGMA.—Reported by W. W. Dawson, M. D. Mr. K., a gentleman 51 years of age, a me-

chanic, of good habits and excellent health, received a wound in the foot by stepping upon a nail. The iron penetrated the foot about midway between the great toe and its neighbor, and a short distance behind the junction of the two.

I saw this patient with Dr. Rogers on Saturday, the 11th of March, the fifteenth day after the receipt of the injury. The wound healed promptly, with but little if any suppuration. On the eleventh day he was exposed to cold and night air, and on the twelfth day he complained of some rigidity and unpleasantness about his jaws. On the thirteenth day Dr. Rogers was sent for and found trismus well marked. He immediately placed him upon 40 grain doses of hydrate of chloral every two hours, and he was kept upon it alone until the evening of the fifteenth day. The chloral kept the patient quiet, induced sleep, but the disease steadily advanced. When I saw him he was in the following condition: Skin moist and cold, temperature 84; pulse 120 and feeble; countenance anxious and marked tetanic grin; trismus intense; muscles of the back and sides of the neck firmly contracted; injured limb rigid; respiration abdominal. After a consultation with Drs. Rogers, Elstun, Langdon and Jones, the patient was given the calabar bean tincture, three drops every four hours hypodermically, and fifteen drops by the mouth at the same interval. Eighteen hours after his temperature came up to 90; twenty-one hours to 91, and at the end of twenty-four hours to 98. His skin lost its moisture and became normal, his pulse fell to 110. His countenance lost the tetanic grin and presented a calm and happy expression. The trismus, opisthotonus, and rigidity of the limb less marked.

Thus far the bean had an unmistakable impression, but under its use convulsive actions were developed, accompanied by great distress and restlessness. Immediately after a spasm the pulse showed 130, soon fell to 110. The pain and restlessness were controlled to some extent by a return to



the chloral, but at 9½ o'clock on the night of the sixteenth day he died in a violent convulsion.

In analyzing this case it is apparent that the chloral acted as a hypnotic, but exerted no influence whatever upon the progress of the tetanus. The conduct of the physostigma was striking, it banished the tetanic grin, brought up the temperature from 84 to 98, warmed up the skin, reduced the pulse from 120 to 110 and gave it force, and lessened the muscular rigidity, but was not sufficient to control the disease.

**CASE OF CHRONIC TETANUS TREATED BY HYDRATE OF CHORAL.**—A patient was admitted to the Cincinnati Hospital during the past winter, with tetanus of ten days standing, the result of a slight scalp wound. Opisthotonos, trismus, abdominal rigidity and great epigastric distress. In this case the chloral was used, and in controlling the pain it was successful. The tendency in cases ten days old is towards recovery, and I could not see that the remedy had any effect whatever, except that which I have already indicated—it allayed suffering and induced sleep, whilst the tetanus exhausted itself.

#### CASES ON DELIRIUM TREMENS.

Four cases, reported by E. Hadly, M. D., of Indianapolis. First case gave 5ss of chloral at night; following morning found him in a half dozing condition; repeated dose, after which he slept well. Restlessness increased again at night; then gave ʒi of chloral, an hour later he was sleeping soundly. Next morning called for breakfast and ate heartily; from this time gradually improved.

Second, third and fourth cases were similar and with like good results.

Six cases reported by Dr. Balfour, *Edinburg Medical and Surgical Journal*, May, 1871. First one of maniacal ferocity, and had been under treatment for three days. Two

doses of chloral, 30 grains each, with an interval of an hour between them sufficed to induce refreshing sleep and restore patient to health. The five other cases of varying degrees of severity, all with most satisfactory results.

Three cases reported by Dr. W. J. Nichol, Nashville Journal, August, 1870. Chloral was given in 20 grain doses, at intervals of two hours. In each it was only necessary to repeat the dose once, sleep being induced.

Two cases, reported by C. A. Stivers, M. D., of San Francisco Pacific Medical and Surgical Journal, Aug. 27th, 1870. Both cases had to be confined in a jacket. First case took 5ii divided into four doses, in fourteen hours. Following day was discharged from treatment. Second case only required two 30 grain doses, with like result.

One case by Wm. S. Bowen, M. D., Asst. Surg., U. S. N. Male: aged 27; Seaman. Maniacal delirium; had been under treatment for three days. On admission gave 30 grains of chloral, an hour later 20 grains. Six and a half hours after he became more excited, and the hallucinations increased; gave then 5j. Five minutes after he was seized with convulsions, similar to those of a person partly under the influence of *ether* or *chloroform*, and he unconsciously passed a large quantity of urine, this was followed by profound sleep, from which he did not awake for eleven hours, when he immediately asked for his breakfast, ate a hearty meal, then had several hours sleep.

CASE OF FAILURE.—London Hospital, London Lancet, page 804, June 4th, 1870. Male: aged 33. Took 20 grain doses; after taking five doses was quiet for half an hour, but no sleep. Chloral was continued for two days, was then placed on morphia, which produced sleep.

Three cases by Charles Murchison, M. D., L. L. D., F. R. S., Oct. 29th, 1870; L. L., page 596. First case gave 5ss every four hours; after second dose slept fourteen hours. Second case gave 5ss every four hours; after fourth dose had

a prolonged sleep, on awakening from which the symptoms of delirium tremens had almost disappeared, but he rapidly sank from an extension of a recent attack of pneumonia and died in three days.

Third case constant vomiting; gave bismuth and chloral, each 5ss every four hours; after six doses vomiting stopped. Chloral was continued as before, for two days, patient sleeping at intervals.

Two cases under care of Mr. Lansdown, Bristol Gen. Hospital. First case J: aged 41; compound fracture of tibia and fibula. Third day after admission delirium tremens came on; 30 drops of the liq morphia was administered hypodermically, but produced no effect. Then gave 5i of chloral, this made him drowsy for a minute and nothing more. Thirty minutes after another 5i was administered, in a short time he fell into a sound sleep which lasted for two hours. Then gave 5i, after which he slept for several hours. He was much better, no delirium; gave 5i following night.

Second case. Female: age 57; fracture of tibia; third day attacked with delirium tremens. Gave 30 grains; excitement increased. She then took a 5i without effect; in half an hour dose was repeated; this did not absolutely quiet her; again repeated dose in half hour. This finally quieted her, after which she had a deep sleep, breathing heavily, but presented no cause for alarm. After this sleep she was free from delirium, but two doses of 5i each was subsequently given, simply to procure rest. Of these two cases the man took 5iii in first six hours, the woman took same quantity in one hour in addition to 5ss she had taken during the day.

Case by Henry T. Chapman, M. D., London Medical Times & Gazette, page 419, Oct. 2d, 1869. Male: age 60; three previous attacks, sleep had been procured by morphia. In this attack it signally failed. Five hours after the last ineffectual dose of morphia gave 30 grains of chloral. In less than five minutes he was asleep, and slept heavily for nearly an hour,

the muttering and convulsive movements ceasing entirely after half an hour. On waking he was quite composed and rational, drank some brandy and water, took 20 grains more of chloral, and again fell into a lethargic sleep, which lasted seven hours, after which he steadily improved.

Delirium tremens is one of the many maladies in which chloral has been used with advantage. It is a remedy for producing sleep, particularly in those cases where opium is contra-indicated. It does not interfere with elimination by the kidneys like opium; the existing impurities of the blood favor the action of chloral by assisting in the liberation of chloroform. One caution with regard to it is necessary. Not only in this disease, but in others, the first action of chloral is rather exciting than sedative, and when continued will often produce the desired sleep.

#### CASES OF CHOREA.

CASE 1.—By Dr. Britton, *London Lancet*, page 634, Nov. 5th, 1870. Patient aged 9; began to show symptoms of chorea three months previous to presenting herself for treatment; at this time she could neither articulate any words nor sit still in a chair, nor walk. If left alone she would fall out of her chair. She could not eat, so great was the difficulty of swallowing. After treating her for six weeks with iron quinine, sulphate of zinc, strychnia, bromide of potassa and digitalis, without improvement, gave 10 grains of chloral at bed-time which procured her a good night's rest, followed by marked improvement during the day. This treatment was continued for four nights, and in two weeks was discharged well.

CASE 2.—By Dr. James Russell, *Medical Times and Gazette*, page 30, Jan. 8th, 1870. Chorea during pregnancy. M. E. M., aged 21, five months advanced in pregnancy, with first child. Choreic movements developed themselves



from an unusually early period of gestation almost from beginning. For two or three weeks previous to treatment movements had become violent, so that she was unable to stand, and was confined to her bed. Sleep very much disturbed. Lost the power of articulating. Full doses of bromide of potassa failed entirely; then gave in twenty-four hours seven doses of chloral. First two doses 10 grains each, succeeding ones of 15. First two doses procured some sleep, but after the third sleep became more continuous, lasting successively for three, five, and three and a half hours. While awake the movements were much less. She was kept under the influence of chloral for ten days and in one month thereafter discharged, nearly well.

#### MANIA.

CASE 1.—By Alex M. Adams, M. D., London Lancet, Jan. 22d, 1870. Slender, delicate looking woman; four days after confinement attacked with ungovernable mania; shaved head and applied leeches and ice; gave 5ss bromide of potassa, and repeated it in two hours; mania continued; twenty-five hours after attack gave 40 grains of chloral; in five minutes she was calm, in ten minutes fell asleep. The mania being periodical chloral was given at times in 40 to 60 grain doses for a fortnight with favorable result.

CASE 2.—By A. H. Hunt, M. D., Medical and Surgical Reporter. Female: dementia of eleven years standing, a very noisy case; was treated with marked success by chloral in 10 grain doses as required.

CASE 3.—Thomas H., age 62: periodical insanity of 30 years standing; 10 grains of chloral always produced five to six hours sleep.

CASE 4.—Jane C., age 60; despondency and melancholy of a suicidal nature. Four years standing; was decidedly benefitted.

CASE 5.—M. T., age 52, acute suicidal mania of five years standing, supposed to be caused by uterine trouble. The patient is laboring under the delusion that she is debarred from the privilege of entering heaven. She was easily controlled by chloral. He also reports five other cases controlled by chloral, 10 to 20 grains producing five to six hours sleep.

W. J. Elstun, M. D., in a paper read before the Indianapolis Academy of Medicine, reports five cases of insanity, where chloral produced quietude or sleep in each for several hours, but had no perceptible effect in allaying the mania.

Dr. Clouston, Medical Superintendent of the Cumberland and Westmoreland Asylum, says that it is a certain sleep producer, that by the use of chloral, attacks of insanity may probably be warded off in some cases; that its action is especially applicable to recent cases of insanity, or to subdue temporary excitement.

He, however, states that whether it does good or not it *never does harm*, and in this respect is *king of all NARCOTICS*.

#### PUERPERAL CONVULSIONS.

CASE 1.—By R. D. Fox, M. D., London Lancet, July 16th, 1870, page 101. E. S., age 15½: primipara in labour eight hours, and had progressed satisfactorily till a few minutes before I was called, when, the head having begun to press well on the perineum, the girl went off into puerperal convulsions. Fits were frequent but not powerful, sensible during the intervals. Ordered at once some calomel, sinapisms to neck and turpentine enema. Four hours later fits more severe and frequent; two hours later fits almost continuous; totally unconscious and very much exhausted. Delivered her with forceps of a dead and partly decomposed child. The fits then for four hours increased in severity and frequency, pupils dilated and hardly acted at all. She

had a feeble pulse of 100. Gave 30 grains of chloral, saw her two hours later, had only one fit, pupils normal and acting. Eleven hours later she was in a fitful sleep, tossing about the bed a good deal, and with occasional twitching. Gave the second 5ss of chloral; followed by a quiet sleep of six hours. Then gave 10 grains every four hours, in a mixture, with small doses of digitalis, hyoscyamus, and bicarbonate of potash; continued to improve. No family or previous history of epilepsy.

CASE 2. By A. C. Campbell, M. D., *London Lancet*, page 153, July 30th, 1870. Mrs. J., age 28; primipara, full time, along with the first labor pains a very severe epileptic convulsion made its appearance, the paroxysms recurring every half hour, at the commencement of each labor pain, and leaving her unconscious during the intervals; gave 40 grains of chloral, no return of convulsions; pains increased, both in strength and frequency. She remained insensible and quiet, only being aroused by the pains. Delivered in three hours after administering chloral, of still born child. One hour later left her sleeping soundly, having no knowledge of a child having been born. Three hours after delivery convulsions recurred with more or less severity every fifteen minutes, along with after pains. Thirty grains of chloral was given, and in 20 minutes she was asleep and slept well all night, no return of convulsions. Made a good recovery.

CASE 3.—Reported by Baron Paul von Sergdewitz, of Bale, (*British Medical Journal*), to the Obstetrical Society of London, case of violent puerperal convulsions in a woman suffering from endocarditis, subsequent to delivery, in which chloral at once arrested the fits, after various other remedies had been used in vain.

CASE 4.—By Dr. Milne; *Edinburg Medical Journal*, May 1870. The case was purely a psychical one, due to the shock of a sudden, loud and unexpected sound; the benefit he ob-

tained from chloral was considerable, although not sufficient in his estimation to send one into ecstasies, or impress one with the belief that a novel cure had been brought before us of unexampled power.

CASE 5.—Communicated to the Imperial Surgical Society, March 23d, 1870. Puerperal eclampsia in a primipara; convulsions came on during labor, and continued after delivery. All the ordinary remedies having failed to afford relief, chloral was had recourse to, in increasing doses, commencing with 4 grammes. When the dose reached six grammes, the patient fell into a deep and quiet sleep, which continued for twelve hours. After awakening, she had slight attacks, which were relieved by chloral, and complete recovery ensued.

#### PARTURITION.

E. Lambert, house Surgeon, Maternity Hospital, Edinburgh, reports eleven cases of parturition, with the following results :

CASE 1.—Intolerance of medicine.

CASE 2.—A very quiet woman, devoid of excitability. Result favorable.

CASE 3.—The marked effect was a bringing about regularly of the recurrence of pain, and the great relief that she said the medicine gave her.

CASE 4.—Negative result.

CASE 5.—Parallel of case 2.

CASE 6.—Refractory.

CASE 7.—Ergot and chloral administered conjointly ; too much antagonism.

CASE 8.—Marked cerebral disturbance for a short period.

CASE 9.—Very favorable result, but marked by the occurrence of sub-delirium half an hour after delivery.

CASE 10.—Perfect anaesthesia for half an hour.

CASE 11.—Painless labour throughout.



His conclusions are that chloral is an agent of great value in the relief of pain during parturition, and as demonstrated, labour can be conducted from its commencement to its termination, without any consciousness on the part of the patient, under the sole influence of chloral. The effects being continued beyond the completion of labour and the repose experienced by the patient after labour, is one of the favorable circumstances to be noted in considering its application to child-birth.

Chloral not only does not suspend, but rather PROMOTES UTERINE CONTRACTIONS by suspending all reflex actions which tend to counteract the incitability of the centers of organic motion. Labours under chloral will probably be found to be of shorter duration than when natural, for unconscious contractions appear to have more potent effects than those which are accompanied by sensation of pain. It should be exhibited in fractional doses, say 15 grains every quarter of an hour, until the required effect is produced.

#### PERTUSSIS.

"Alex. M. Adams, M. D., in London Lancet, Feb. 5th, 1870, reports having treated several cases of whooping cough in children five to six years of age, with 5 grains two or three times daily. If cough is worse at night increase the dose." I have found it a most valuable remedy, having treated many cases of whooping cough with favorable results, varying the dose from three to seven grains and repeating dose as necessary to allay coughing.

Dr. A. Ferrand reports in the Bulletin De Therapeutique several cases with unbounded success, no coughing at night, but sweet refreshing sleep.

#### ASTHMA.

Several cases of asthma have been reported as being successfully treated by chloral. Dr. A. J. Miles, of this city,

presented me with reports of a number of cases of asthma which he treated with chloral in 5ss doses, the second dose generally producing the required result.

AMPUTATION DURING ANAESTHESIA, PRODUCED BY CHLORAL.—Dr. Noir published in London *Lancet*, Jan. 1st, 1870, a case of a man aged 64 suffering from osteo sarcoma of the leg. The patient was anxious to have limb amputated. Eight, A. M., took 60 grains of hydrate of chloral; up to 9 o'clock he frequently tried to vomit, with violent excitement, until 10 A. M.; he then fell asleep, and was insensible to so great an extent that he could be moved freely without waking. Sleep lasted one and a half hours; he awoke and wanted something to eat. Two days after took 75 grains at 8 A. M.; was uncomfortable for an hour, when he fell into a deep sleep, and underwent amputation of leg without moving or uttering a sound; the coma was so alarming and prostration so complete that Dr. Noir remarked that it would be *imprudent* to use chloral as an anaesthetic in operations if it continues to be followed by these dangerous symptoms. There can be no doubt but that the anaesthesia was complete.

Discoveries like this have long histories, and the efforts are often misdirected, the experiments insufficiently recorded, and the conclusions erroneously drawn from the crumbling dust of errors and imperfections.

If we were to refer to various formed essays upon therapeutics that have appeared of late years, we would find that a certain timidity, has in many instances, induced authors to cling to phrases which represent physiological theories *now* virtually dead—and the use of these phrases has injuriously affected the value of our systematic teaching, on the subject and action of medicine, leading energetic and practical men to regard it as somewhat pedant and unreal, and hence the many misdirected uses, and entire failures which otherwise might have properly contributed praise according to deserts.

It is the general custom of writers on therapeutics to assume that the same qualities which distinguish the action of any drug when administered in large doses, must distinguish it when administered in a smaller quantity and *vice versa*, the only difference being of degree and not of kind.

Thus: opium in a medicinal dose produces sleep, in a poisonous dose coma, the latter cause being argued as the extreme development of the other.

If the dogma that the action of a drug is essentially the same though not in degree, be true in any sense, as would warrant its being assumed as a basis of therapeutical inquiry it ought to be true universally—but not so.

Thus: common salt in small quantities is a perfectly indispensable article of human food, in a medium dose a safe and useful emetic medicine, while in extremely large doses it is an irritant poison and has caused death. (Med. Gazette vol. I., p. 559—1840.)

The same might be said of iron, which is one of our most valuable tonics, given in small doses, but in large quantities it is a most violent irritant, and will poison. So with strychnia and arsenic in their therapeutical dose we have a powerful tonic, and are often the resort in extreme cases, but in large quantities they tell in action louder than words. The same might be said of chloral, whose therapeutical action consists in a regular progressive extinction of the vital properties of the various portions of the nervous system.

Producing first, with a small dose calmness and tranquility as shown in Dr. Patton's case, (case 6th in our report on neuralgia.)

2d. Producing deep sleep, insensibility, as shown by Dr. Richardson in his experiments upon the pigeon, and as shown by Dr. J. C. O. Wills' case (case 4th neuralgia) when deep sleep was produced for 7 hours.

3d. Deep sleep with complete anaesthesia, as in the

pigeon when  $2\frac{1}{2}$  grains were given. As illustrated by Dr. Chapman's case of delirium tremens.

4th. Complete insensibility as when 5 grains were given to the pigeon, and as recorded in Dr. Noir's case of amputation when 75 grains were taken at one dose.

6th. Death as when seven grains were given to the pigeon but not as yet verified on man.\*

My experience with chloral has shown that a small dose first produces a slight invigoration, with face bright and intelligent, only to a degree proportionate as shown in perfect health, or owing to the ratio it exerts itself upon the physical characters of the corpuscles before it diminishes the power of the organic constituents of the blood to unite with oxygen.

2nd. With the dose increased *pro re nata* we have the coordinate voluntary movements affected, then impairment of consciousness with a sweet sleep following. Fall of temperature and respiration; giving the full effects of a hypnotic, with all the pleasing results that could be wished for, or in other words producing natural sleep. The same results having been corroborated by Dr. Ferran in his cases of pertussis.

3d. I find that by increasing the dose proportionally to the person, we next produce a deep sleep with insensibility, that will last for hours even with noise and jostling around but no dreams, the sleep seemingly being too deep, and having on waking a tendency to depression. The depression that I have witnessed after giving large doses of chloral, seemed to have prostrated Dr. Noir's man after amputation so much that he became alarmed and remarked that it would be imprudent to use chloral as an anaesthetic in operations if it continued to be followed by these dangerous symptoms. Its effects upon a healthy system has no comparison with other hypnotics or anaesthetics.

The ancient Egyptians used many drugs for producing a state of intoxication or ecstasy; consisting of Indian hemp

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\* Since writing the above one death has been recorded.



and the juice of the poppy, and when opium was scarce they used the "electuarium bernavi." The effects of these preparations of Indian hemp were, first exhilarating, then the men became talkative and would sing love songs and laugh; then they were rendered delirious and would fight and mutilate each other; then after an hour or so came a stage of wild excitement, with violent anger; lastly a stage of grief during which they lament and weep, then they return to normal health. Prosper Alpinus gives the formula, white poppies, seeds of henbane, opium, stem and flowers of euphorbia and saffron. The effects may be imagined from the nature of the ingredients.

The ancient Scythians used to breathe the fumes of burning hemp, just as the Hindoos do now; just as the Chinese smoke opium. The custom of inhalations, too, was very widely spread among the barbarians along the shores of the Caspian, who lit fires of fruits and seeds, and sat around them breathing the fumes, till they became intoxicated; or as the Indians who throw tobacco on their fires during religious ceremonies, to transport them into ecstasy; or as the priestesses at Delphi who became half intoxicated by the fumes of narcotic plants, before delivering the oracles. In the 12th century the famous confection of Hugo di Lucca\* was used to produce sleep. And these usages no doubt had a tendency to lead to the search and discovery of anaesthetics.

Opium eaters who are so abundant over our land, say that they eat it for the happy effects and pleasing sensations that it produces upon the healthy economy, and some become so accustomed to it that they can tolerate enormous quantities. Chloroform produces dimness of vision, then exhilaration with disposition to talk, laugh and sing, dreams and fancies occur, events of past life may be recalled, conversations may be repeated and actions produced. Sailors sometimes go

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\* Composed of opium, henbane, mandragora and hemlock mingled with various juices.

through their nautical maneuvers, young ladies will sing "Beautiful Star," some will pray, some swear, and others will relate their love mishaps. But not so with chloral, it has no tendency to produce any such state of ecstasy as Indian hemp, or the pleasing effects of opium, neither has it any of the exhilarating tendencies of chloroform when inhaled, though the active principle is chloroform liberated in the blood. Hence we have the full assurance that it can not be used by the common people to abuse themselves with—producing their supposed happiness. This property of the drug is one of the best recommendations to its adoption into common use.

This genial idea that was implanted at an early day and beautifully described by Helen to Menelaus when she offered him the "sleeping" cup:

"To clear the cloudy front of wrinkled care,  
And dry the tearful sluices of Despair:  
Charm'd with that virtuous draught, the exalted mind  
All sense of woe delivers to the wind."

Though once developed into boldness and almost general use, and is even now destroying the happiness of thousands of families and homes, should be superseded—old systems should be discarded and new ones adopted for reformation if nothing more. And chloral I am proud to say will not admit of being used, so that our fellows can be called "chloral eaters." True the use of chloral will produce sleep and destroy physical pain, but the exhilarating effects, such as opium produces, are absent in chloral. It will cause no change in the senses as its action prevents oxygenation, it diminishes the arterial supply, causes a sluggishness of flow in the capillaries; then extending to the nerve filaments distributed to the lungs, producing shallowness of respiration. From its effects, due to the influence of an altered blood, suspended oxygenation, we can not foresee any abuse that it may be liable to by the common people.

By our own trials and the summary of all the cases that have presented themselves, we find that hydrate of chloral affects the human system as per the statements of Dr. Oscar Liebreich, who described it as first effecting the ganglionic cells of the brain, and the coordinate voluntary movements and impairing consciousness, holding in check only partly voluntary motion. The effect is then, if carried far enough, communicated to the medulla, whereby stertorous and laborious breathing is effected, and lastly the ganglionic cells of the heart, but this last has been verified only on the lower animals. Considering its daily and almost universal use there is no agent which seems to us to require more caution and more skill to obtain the good and avoid the evil which its use entails.

The dose of chloral must be regulated by the physician. My experience is that it should be used in fractional doses and repeated until the desired effect is produced, grsxx being nearly the standard dose.

